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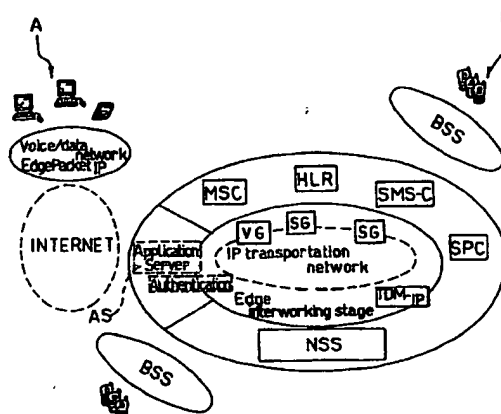
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(54) Title: **METHOD FOR ACHIEVING THE INTERACTION BETWEEN TERMINALS OF TELECOMMUNICATION NETWORKS AND RELATED SYSTEM**



(57) Abstract: A calling terminal (A) configured for transmission on a transport network IP is connected with a called terminal (B) connected on a mobile telephony network (PLMN) provided with modules of the MSC (Mobile Services Switching Center), VLR (Visitor Location Register) and HLR (Home Location Register) type. In the IP transport network are provided signaling gateway (SG) modules able to communicate with the HLR of the mobile telephony network, as well as voice gateway (VG) modules able to convert the signal into voice and the related signaling from the IP network transport format compatible with the MSC of the mobile telephony network. The calling terminal (A) generates a call message which is routed towards the application server (AS). Here the signaling gateway (SG) able to communicate with the HLR whereon the called terminal (B) is registered is determined, thus locating in which area of said mobile cellular telephony network the called terminal (B) is situated. The vocal gateway (VG) is then selected in a corresponding MSC whereon to terminate the call, which is set up connecting the calling terminal (A) and the called mobile terminal (B) through the MSC-VLR thus identified.

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**"Method for achieving the interaction between
terminals of telecommunication networks and related
system"**

* * * * *

5 Technical Field

The present invention relates to communication networks and it was developed with particular attention to the possible application in achieving the interaction between packet switched networks in IP (Internet Protocol) technology and mobile networks in GSM/GPRS technology for
10 supporting integrated voice-data services towards mobile terminals.

The invention was developed with particular attention to operators of mobile radio networks for
15 telecommunications provided with their own geographic network in IP technology or able to exploit a geographic network infrastructure in IP technology of a third party, such as a so-called Network Service Provider or NSP.

Background Art

20 As a foreword both to the description of the prior art and of the solution according to the invention it may be useful to recall the fact that the elements comprising the architecture of a telecommunications network are usually divided in two different domains: the user domain and the
25 network domain.

The user domain is composed by the terminals employed by users to exploit the services offered by the network. In general, there are usually two types of terminals: fixed network terminals (in particular new generation
30 terminals such as Personal Computers provided with VoIP Client interface with microphone and speakers or IP telephones) and mobile network terminals.

The network domain in turn is subdivided in two different domains: the traditional domain or circuit
35 switched network for the mobile network (for instance GSM) and the packet switched network or network in IP technology.

The elements belonging to the domain of the traditional technology network are in turn subdivided - still referring by way of example to the GSM standard - into the BSS (Base Station Sub-system) or radio part and
5 NSS (Network Switching Sub-system) or core network.

The BSS is the set of functional elements that provide for the radio aspects of the systems, of the radio coverage of one or more cells and of the communication with the mobile terminals located within them. The BSS
10 comprises two functional units, respectively called BTS (Base Transceiver Station) and BSC (or Base Station Controller).

The NSS is the set of functional elements, switches, databases, etc., that allow to manage user mobility and to
15 control calls and support supplementary services. The most important elements belonging to the NSS are constituted by the MSC (Mobile Services Switching Centre), by the VLR (Visitor Location Register) and by the HLR (Home Location Register).

20 The MSC element essentially corresponds to the switching centre for mobile radio services and it has two fundamental tasks: managing mobility and routing calls for the served area.

The VLR corresponds in practice to a database
25 associated to each MSC in which are temporarily stored the information of the mobile terminals in relation to the area served by the MSC whereto it is associated.

Lastly, the HLR is the central database that permanently stores both the users' subscription data
30 (known as static data), and data that may vary as a result of the users' actions, such as moves or activation of supplementary services (the latter data being known as dynamic data).

Persons versed in the art will appreciate that the above
35 statements referred specifically to the functional elements MSC (Mobile Services Switching Centre), VLR (Visitor Location Register) and HLR (Home Location

Register), characteristic of the GSM standard, applies identically also to elements with equivalent functionalities provided in other mobile radio telephony standards, such as AMPS (Advanced Mobile Phone System),
5 PDC (Personal Digital Cellular) or NMT (Nordic Mobile Telephone). It is therefore understood that the terminology "of the MSC, VLR or HLR type", as used in the claims that follow, is such as to include within the scope of the present invention the solutions which, while they
10 do not exactly use the typical terminology of the GSM standard, use functional elements equivalent to those expressly mentioned above.

Figure 1 of the accompanying drawings exemplifies, as an immediate reference, the procedures used to perform a
15 call between a fixed telephone and a mobile telephone with reference to a transport network in traditional technology, for example TDM SS7 voice and data, based on the use of the three protocols currently called MAP (Mobility Application Part), CAP (Camel Application Part)
20 and ISUP (ISDN User Application Part). The terminology in question must be considered wholly clear and understandable for those versed in the art.

In particular, it will be assumed that the user who employs a fixed telephone, indicated as A, is connected on
25 a fixed network of the PSTN or ISDN type and wants to call a mobile network user, indicated generically as B, connected to a mobile network of the type currently called PLMN (Public Land Mobile Network).

To complete the call, the fixed network user A dials
30 the number (MSISDN, acronym for Mobile Station ISDN Number in E.164 format) of the mobile terminal B.

The number of the mobile terminal B is analysed by the involved switching centres (PSTN/ISDN). The switching centres interpret the number, comprehending the fact that
35 they have to route the call to the so-called GMSC, i.e. the gateway MSC (GMSC) of the mobile network PLMN whereto the terminal B belongs.

The MSC receives a call set-up message, in ISUP signalling (see the terminology note provided above) containing the MSISDN number. This number is analysed determining the HLR on which the mobile terminal B is registered and sending a MAP signalling message to it to locate the area of the PLMN cellular network where the terminal B is positioned.

The HLR in question identifies, based on the MSISDN number, the IMSI (International Mobile Subscribe Identity) identifier associated to the terminal B - more specifically, to its SIM - and the VLR whereon the mobile terminal B is temporarily registered, then sending, also in MAP signalling, a request for the MSRN number (Mobile Station Roaming Number in E.164 format) which indicates the localisation area of the mobile terminal B and hence of the related MSC whereon the call is to be terminated.

The HLR receives the MSRN number and provides it, also through the MAP signalling, to the gateway GMSC. The latter analyses the MSRN number and routes the call (propagating the so-called call SET-UP) to the MSC that is temporarily responsible for the mobile terminal B, carrying out the call set-up step through ISUP signalling. In this way, the connection is extended, also through any transport network in TDM technology, to the MSC-VLR that controls the localisation area where the mobile terminal indicated as B is present. At this point, the MSC-VLR sets up the call through the BSS radio interface, carrying out the normal paging procedures provided for this purpose.

The above substantially apply also in the case, shown in the diagram of Figure 2, in which the calling terminal A is a Personal Computer accessing the network, for instance, via modem and ITSp, i.e. a so-called Internet Telephony Service Provider.

In this case, access always takes place by means of PSTN switching centres towards the ITSP network (NAS, Network Access System of the related Internet point of presence or PoP).

The fixed network user A in this case is equipped with a multimedia Personal Computer provided with a Client VoIP functionality able to encode and packetise voice, authenticate and route the call by means of a corresponding control module (for example a so-called Gate Keeper or GK in the architecture according to the ITU H.323 standard).

The calling terminal A dials, in this case as well, the number (in E.164 format) of the ITSP for connection to the Internet. Said number is analysed by the involved PSTN/ISDN switching centres, which interpret it as relating to a data call and route the call towards the nearest PoP of the provider's NAS system. After completing authentication procedures, the user accesses the Internet, said step being based on the ISDN access signalling.

The Client VoIP functionality available on the Personal Computer then dials the MSISDN number, sending in IP signalling a request for the IP address whereon the call is to be routed.

Based on the MSISDN number, the aforesaid control module provides the IP address of one of the vocal gateways GW; the latter serves a dual purpose:

- setting up the call providing for the conversion of the signalling flow of the IP domain to the TDM domain, and
- accomplishing voice conversion in conforming fashion.

The procedures are therefore the same as those described above with reference to Figure 1.

It is evident that the interaction between the packet-switched networks in IP technology and mobile networks, for instance in GSM/GPRS technology for supporting integrated voice-data services between personal computers and mobile terminals takes place according to criteria that are far from optimal, if carried out according to the procedures illustrated with reference to the previous Figures 1 and 2. This is because, in essence, the call

towards the mobile terminal B is set up - with reference to the procedures illustrated in Figures 1 and 2 - using the signalling functions of the involved networks, and in particular of the PLMN network whereto the called terminal
5 B belongs. All this to perform functions that in fact can be carried out directly by the elements belonging to the packet domain, i.e. by the signalling and voice gateways in order to convert the related information between the two domains (traditional and packet switched) and by the
10 control module (application servers for managing the services and routers for routing traffic).

The aim of the present invention therefore is to provide an enhanced solution to allow a calling terminal, such as a telephone terminal configured with a module
15 (VoIP) for voice transmission on a transport network IP by means of a respective application server (AS), to call in voice and/or data connection a terminal connected on a mobile telephony network (PLMN) provided with modules of the MSC (Mobile Services Switching Centre), VLR (Visitor
20 Location Register) and HLR (Home Location Register) type. In regard to the meaning to be attributed to the expression "of the MSC, VLR or HLR type", the reader is again referred to the terminology foreword set out above.

Disclosure of the Invention

25 According to the present invention, said aim is achieved thanks to a method having the characteristics set out specifically in the claims that follow.

The invention also relates to the associated system.

Substantially, the solution according to the invention
30 allows to connect a calling terminal connected to a network with IP technology with a called terminal connected on a circuit switched mobile telephony network, keeping substantially free the signalling function of the circuit switched mobile telephony network; this is because
35 the call is routed directly through said network in IP technology.

In particular, in the currently preferred embodiment,

the solution according to the invention exploits the fact that the application server available at the packet domain is able to:

- authenticate the calling user, through an authentication server,
- locate the user to whom the call is destined by communicating with the databases of the mobile network (HLR) through the signalling gateways, verifying for example whether the recipient user is present in the network (under coverage and activated),
- set-up the call, through the voice gateways, and
- handling billing and controlling the call.

In particular, the signalling gateways allow interworking between the traditional network and the IP technology network in regard to localisation signalling (Mobility Application Part or MAP), whilst voice gateways are able to handle that the signalling for controlling the call and setting the call up on IP, convert it towards the traditional domain and covert voice between the two domains and vice versa.

Brief Description of Drawings

The invention shall now be described, purely by way of non limiting example, with reference to the accompanying drawings, in which:

- Figures 1 and 2, relating to the prior art, have already been described above,
- Figure 3 shows a possible embodiment of the solution according to the invention, and
- Figure 4 shows in greater detail the procedures for setting up the call according to the criteria whereto reference is made in Figure 3.

Best mode for Carrying Out the Invention

The better to understand the procedures for setting up the call between calling user A and called user B, according to the invention, reference can usefully be made jointly to the diagrams of Figures 3 and 4.

By way of initial operation, the caller A dials

through his/her functionality VoIP (in particular by means of the module called CVS or Client VoIP SIP) the MSISDN number of the called party B.

In the traditional solutions exemplified in Figures 1 and 2, said number is sent to the switching centres PSTN/ISDN involved to be analysed. In the solution according to the invention, said number is instead routed directly on the IP network, directing it to the application server (AS) whereto the calling user A is connected. In particular this takes place by causing, after the authentication step (through an authentication element), the user A to send a call SETUP message - for example in SIP signalling - towards the application server AS.

After receiving the call set-up, the application server AS starts the localisation step. For this purpose, the application server analyses the MSISDN number, determining the signalling gateway SG that allows it to communicate with the HLR whereon the mobile terminal B is registered and sending it a MAP signalling message carried on IP network. All this to localise in which area of the cellular network PLMN the called terminal B is situated.

Also based on the MSISDN number, the involved HLR identifies the IMSI identifier (International Mobile Subscriber Identity) of the called terminal B, determining the VLR whereon the terminal B itself is temporarily registered. In MAP signalling, carried on IP, a request for the MSRN (Mobile Station Roaming Number) is sent (also through the signalling gateway). The MSRN number identifies the area of localisation of the called terminal B and hence the related MSC whereon the call is to be terminated.

The HLR receives the MSRN number and provides it, also through the MAP signalling carried on IP, to the application server. The latter analyses the MSRN number and selects, in relation to the MSC whereon the call is to be terminated, the vocal gateway VG whereon the call is to

be routed. This takes place by means of propagation of the call set-up in SIP signalling.

The vocal gateway VG converts the signalling from the SIP format to the ISUP format and voice from the packet
5 format into normal TDM, sending all to the MSC that is temporarily in charge of the mobile terminal B. At this point, the involved MSC-VLR set sets up the call through the BSS radio interface that is in charge of the mobile terminal B.

10 It will be appreciated that the use of SIP (Session Initiation Protocol) as signalling protocol allows the VoIP functionalities of the calling user A to establish whether the called user B is connected in the network or not, hence to activate the telephone call only if the
15 recipient is present in the network.

It will also be appreciated that the solution according to the invention is suitable for being implemented in corporate scenarios, i.e. in situations in which the IP technology transport network is in fact
20 configured as a corporate Intranet.

Naturally, without changing the principle of the invention, the realisation details and the embodiments may be widely varied relative to what is described and illustrated herein without thereby departing from the
25 scope of the present invention.

CLAIMS

1. Method for connecting a calling terminal (A) connected on a network in IP technology and a called terminal (B) connected on a circuit switched mobile telephony network (PLMN), characterised in that it comprises the step of routing the call through said network in IP technology, maintaining substantially disengaged the signalling function of said circuit switched mobile telephony network.

10 2. Method as claimed in claim 1, characterised in that said calling terminal (A) has associated an authentication module and in that said call is routed following an authentication step.

3. Method as claimed in claim 1 or claim 2, for 15 connecting in voice said calling terminal (A) and said called terminal (B), characterised in that it comprises the steps of:

- configuring said calling terminal (A) with a module (VoIP) for voice transmission over an IP transport network through a respective application server (AS), and

- 20 - providing, in said mobile telephony network (PLMN), modules of the MSC (Mobile Services Switching Centre), VLR (Visitor Location Register) and HLR (Home Location Register) type,

- 25 - providing, in said IP transport network, signalling gateway (SG) modules able to communicate with the HLR of said mobile telephony network, as well as voice gateway modules (VG) able to convert the signal into voice and the related signalling from the IP network transport format into a format compatible with the MSC of said mobile telephony network,

- 30 - generating, at said calling terminal (A), a call message,

- routing said call message towards said application server (AS),

- 35 - determining, at said application server, a signalling gateway (SG) able to communicate with the HLR

whereon is registered said called terminal (B) and locating in which area of said mobile telephony network is situated said called terminal (B), in order to obtain from said HLR a number indicating said located area,

5 - receiving (AS) said number selecting, as a function of said number itself, a vocal gateway (VG) and a corresponding MSC whereon the call is to be terminated, and

10 - setting the call up, connecting in voice said calling terminal (A) and said called terminal (B) through the MSC-VLR thus identified.

4. Method as claimed in claim 3, characterised in that said calling terminal (A) is provided with a CVS module and in that said call message is generated by means of
15 said CVS module.

5. Method as claimed in claim 2 and either claim 3 or 4, characterised in that said calling terminal (A) has associated an authentication module and in that said call message is generated sending it back to said application
20 server (AS) after an authentication step.

6. Method as claimed in any of the previous claims, characterised in that said call message is sent towards said application server using a SIP signalling.

7. Method as claimed in any of the previous claims
25 from 3 to 6, characterised in that said call message is generated in the form of an MSISDN number.

8. Method as claimed in claim 3, characterised in that it comprises the step of sending a signalling message transported on IP network starting from said application
30 server towards said signalling gateway (SG) able to communicate with said HLR whereon is recorded said called terminal (B).

9. Method as claimed in claim 8, characterised in that said signalling message transported on IP network is a
35 signalling message of the MAP (Mobility Application Part) type.

10. Method as claimed in claim 3, characterised in that the HLR with which said signalling gateway is able to communicate identifies, as a function of said call message, the identifier (IMSI) of said called terminal (B) and the VLR whereon said called terminal (B) is registered.

11. Method as claimed in claim 3, characterised in that the HLR with which said signalling gateway is able to communicate generates a request for MSRN number indicating the location area of said called terminal (B) and thus of the related MSC whereon the call is to be terminated.

12. Method as claimed in claim 11, characterised in that said request is sent as a signalling of the MAP type transported on IP.

13. Method as claimed in any of the previous claims, characterised in that it comprises the step of configuring said calling terminal (A) as a telephone terminal, or as a Personal Computer configured with a module (VoIP) for voice transmission on an IP transport network.

14. System for telecommunications configured to implement the method as claimed in any of the claims 1 through 13.

15. IP Network for connecting a calling terminal (A) connected to said network in IP technology and a called terminal (B) connected on a circuit switched mobile telephony network (PLMN), characterised in that said IP Network is configured according to the method as claimed in any of the claims 1 through 13.

Fig. 1

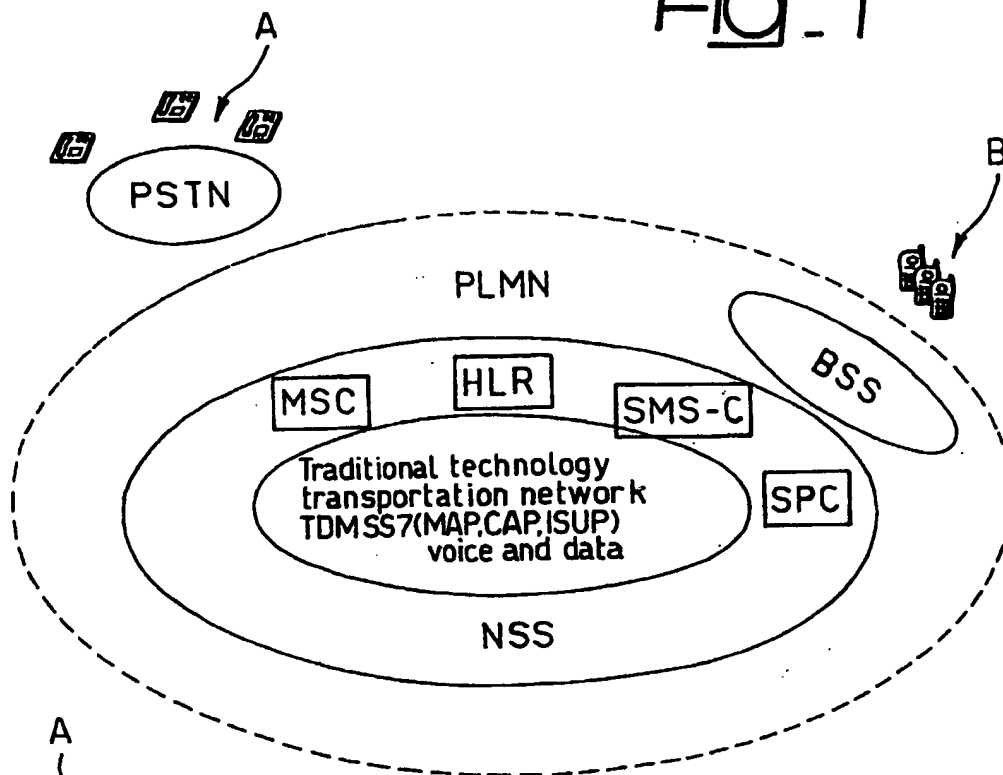
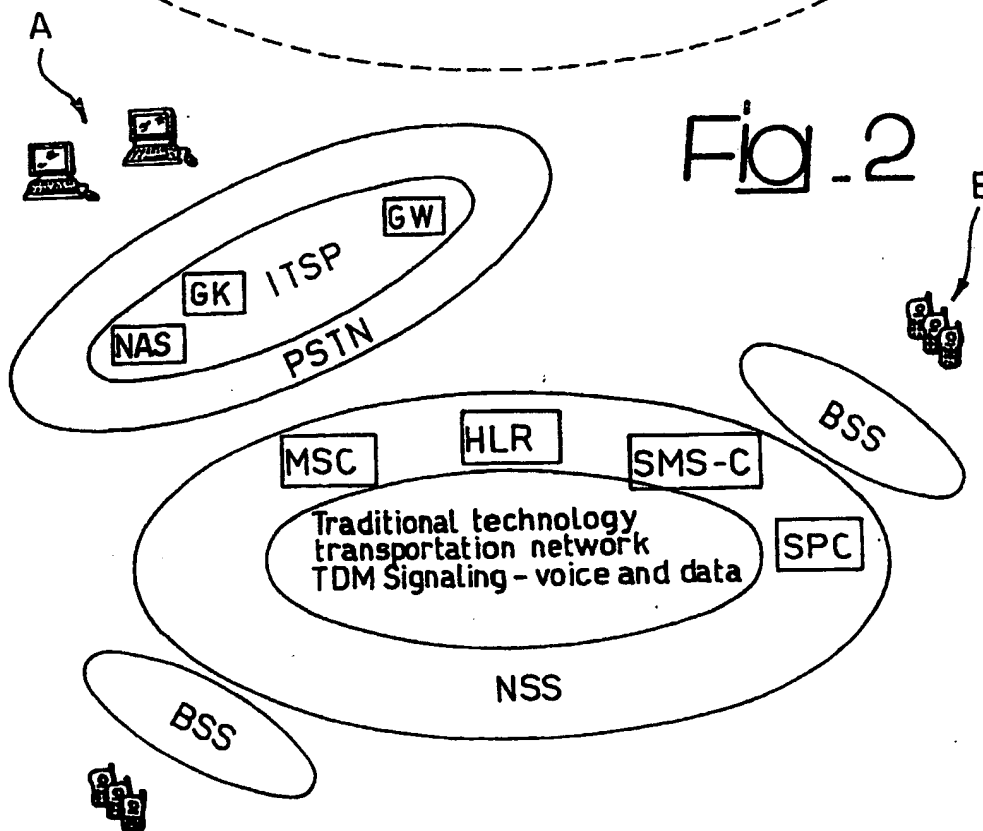
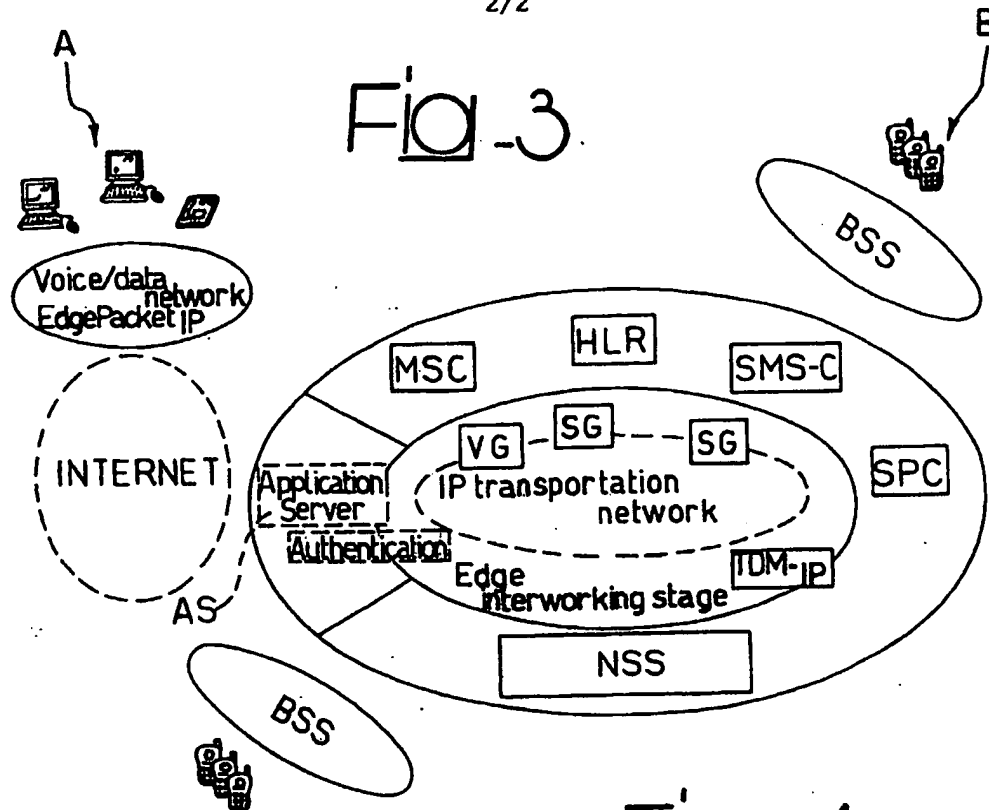
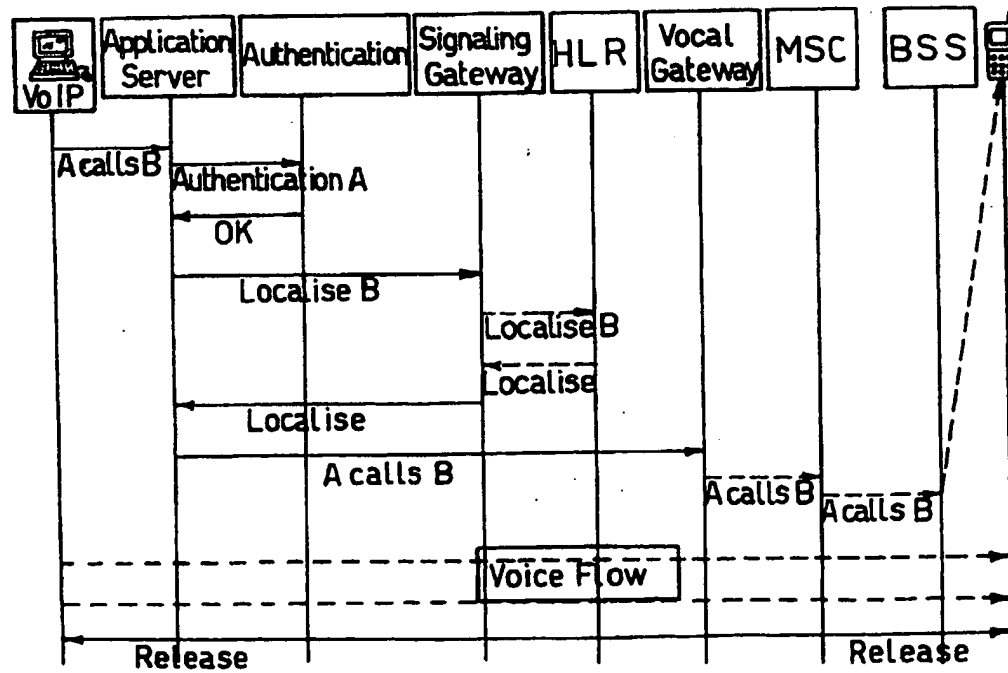


Fig. 2



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**Fig-4**

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 03/00839

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04Q H04L H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

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P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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INTERNATIONAL SEARCH REPORT

International Application No.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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